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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to stable calcium phosphate-synthetic-resin complex and its manufacture approach to moisture while having workability, the outstanding shock resistance, and outstanding biocompatibility.

[0002]

[Description of the Prior Art] Although calcium phosphate is excellent in biocompatibility and is used as biomaterials, such as a dental implant, bone reinforcing materials, and dental cement, since it is the ceramics, it is inferior to toughness, and cannot be used for the part which needs shock resistance. Therefore, a dental implant, bone reinforcing materials, etc. are formed with the metallic material without body harmfulness, such as titanium and stainless steel. However, from a viewpoint of biocompatibility, since the direction of a calcium phosphate system compound is far excellent, to use hydroxyapatite also in a calcium phosphate system compound is desired.

[0003] Under such a situation, to compound-ize a calcium phosphate system compound with a glass ingredient, a metallic material, and synthetic resin is tried, and, partly, it is already put in practical use. However, when it compound-izes with a glass ingredient, there is a problem that glass is eluted with time in the living body.

[0004] The composite of a calcium phosphate system compound and a metallic material is obtained by laying a calcium phosphate system compound particle underground within the metal limit generally, or sintering the mixture of metal fine particles and calcium phosphate system compound fine particles. However, in the case of the former, there is a possibility that gap of a calcium phosphate system compound may arise in the living body. Moreover, in the case of the latter, the calcium phosphate system compound particle exposed on the surface of a compound sintered compact is dedropping and a cone.

[0005] The synthetic resin and the calcium phosphate particle which were fused are kneaded, and although the compound-ized attempt is also performed, there is a fault in which the synthetic-resin particle fused when a calcium phosphate particle tends to have collapsed at the time of kneading and fabrication of the complex was carried out tends to cover the front face of a calcium phosphate particle. Furthermore, there is also a problem that weld flash arises, at the time of cutting.

[0006] Then, this invention persons proposed that the calcium phosphate-synthetic-resin complex which the bridge formation particles of synthetic resin joined on the front face was obtained by carrying out pressurization heat-treatment of a calcium phosphate particle and the bridge formation particle of synthetic resin (application for patent No. 064032 [2001 to]). Although this complex has workability, the outstanding shock resistance, and outstanding biocompatibility, it cannot say that the strength of association between particles is enough, but is swollen under existence of moisture, and tends to become weak.

[0007] Therefore, the purpose of this invention is offering stable calcium phosphate-synthetic-resin complex and its manufacture approach to moisture while it cancels the fault of the above-mentioned

technique and has workability, the outstanding shock resistance, and outstanding biocompatibility.
[0008]

[Means for Solving the Problem] In view of the above-mentioned purpose, wholeheartedly, as a result of research, this invention persons have workability, the outstanding shock resistance, and outstanding biocompatibility, and hit on an idea of stable calcium phosphate-synthetic-resin complex being obtained to moisture to a header and this invention by joining synthetic-resin particles on a particle front face using the synthetic-resin particle II of non-cross-linking with the synthetic-resin particle I which constructed the bridge partially beforehand at least.

[0009] That is, the synthetic-resin particles which consist of a synthetic-resin particle I which the calcium phosphate-synthetic-resin complex of this invention came to carry out pressurization heat-treatment of a calcium phosphate particle and the synthetic-resin particle, and constructed the bridge partially beforehand at least, and a synthetic-resin particle II of non-cross-linking are characterized by having joined on the particle front face. While the synthetic-resin particle was not fused completely but the synthetic-resin particle I had maintained the configuration to some extent at least in this invention, it has joined on the particle front face. Since it has thermoplasticity and softens by pressurization heat-treatment, it is extended and the synthetic-resin particle II of non-cross-linking enters the opening between each particle. Therefore, the opening between each particle is filled up with the synthetic-resin particle II, and the synthetic-resin particle II functions as a binder.

[0010] Although the calcium phosphate particle is firmly held by the synthetic-resin particles I and II in the usual condition, at the time of cutting polish, the particle interface between synthetic-resin particles and the particle interface of a calcium phosphate particle and a synthetic-resin particle separate.

Therefore, a synthetic-resin particle fuses, the front face of a calcium phosphate particle is not covered, and it excels in workability extremely. Moreover, since each particle joins firmly by containing the synthetic-resin particle II, it swells and the calcium phosphate-synthetic-resin complex of this invention does not collapse, even if it excels in reinforcement and moisture exists.

[0011] As for the content of the synthetic-resin particle II of non-cross-linking, it is desirable that it is 0.2 - 50 % of the weight to the total quantity of the synthetic-resin particles I and II. As for the synthetic-resin particle I and/or II, it is desirable to consist of nonaqueous solubility acrylic resin or polystyrene resin, and especially consisting of polymethylmethacrylate is desirable.

[0012] As a calcium phosphate particle used for this invention, it is a porosity particle and what carried out the temporary-quenching join at 500-1300 degrees C beforehand is desirable. As for the mean particle diameter of a calcium phosphate particle, it is desirable that it is 0.001 - 10 mm, and, as for the mole ratio of a Ca/P ratio, it is desirable that it is 1.4-2.0.

[0013] As for the weight ratio of a calcium phosphate particle / synthetic-resin particle, in the complex of this invention, it is desirable that it is 1 / 9 - 8/2. As for pressurization heat-treatment, it is desirable to carry out in the ambient atmosphere (inert gas, such as N₂ gas) which does not contain a vacuum or oxygen.

[0014] Moreover, the manufacture approach of the calcium phosphate-synthetic-resin complex of this invention is characterized by having the process which carries out the temporary-quenching join of the (a) calcium phosphate particle, the process which fills up a die with a synthetic-resin particle and a calcium phosphate particle so that (b) synthetic-resin particles I and II may surround a calcium phosphate particle, and the process which carries out pressurization heat-treatment of the packing in a die so that (c) synthetic-resin particles may join on a particle front face.

[0015] As shown in drawing 1, at the time of restoration, an opening exists, respectively between the calcium phosphate particle 100, the synthetic-resin particle 200 (I) which constructed the bridge partially beforehand at least, and the synthetic-resin particle 200 of non-cross-linking (II). If pressurization heat-treatment is carried out, since the synthetic-resin particle 200 (II) softened as shown in drawing 2 will be extended and the opening between the synthetic-resin particles 200 (I) and between the calcium phosphate particle 100 and the synthetic-resin particle 200 (I) will be filled, synthetic-resin particles serve as structure joined on the particle front face.

[0016]

[Embodiment of the Invention] The calcium phosphate-synthetic-resin complex and its manufacture approach of this invention are explained to a detail below.

[0017] [1] The synthetic-resin particle used for the calcium phosphate-synthetic-resin complex of synthetic-resin particle this invention consists of a synthetic-resin particle I which constructed the bridge partially beforehand at least, and a synthetic-resin particle II of non-cross-linking. The synthetic-resin particles I and II serve as structure joined on the particle front face as drawing 2 by a synthetic-resin particle's deforming, and the thermoplastic synthetic-resin particle's II being especially extended by pressurization heat-treatment, and filling the opening between each particle by it.

[0018] As for the content of the synthetic-resin particle II, it is desirable that it is 0.2 - 50 % of the weight to the total quantity of the synthetic-resin particles I and II. If the content of the synthetic-resin particle II is less than 0.2 % of the weight, complex cannot acquire sufficient stability to moisture. Moreover, when the content of the synthetic-resin particle II is 50-% of the weight **, the workability of complex falls.

[0019] If the above-mentioned conditions are fulfilled and there is no body harmfulness as a synthetic-resin particle used for this invention, there is no limitation and a well-known ingredient can be used. A synthetic-resin particle consists of nonaqueous solubility acrylic resin, polystyrene resin, etc. preferably, and consists of polymethylmethacrylate preferably especially. The synthetic-resin particles I and II may use the same ingredient, and may use a different ingredient.

[0020] As for the mean particle diameter of a synthetic-resin particle, it is desirable that it is 0.05-500 micrometers, and it is more desirable that it is 0.1-100 micrometers. Moreover, as for the mean particle diameter of a synthetic-resin particle, what is smaller than the mean particle diameter of a calcium phosphate particle is desirable.

[0021] [2] As for the mole ratio of the calcium/Lynn of the calcium phosphate particle used for calcium phosphate particle this invention, it is preferably [being referred to as 1.4-2.0], and specifically desirable apatites, such as hydroxyapatite and a fluorine apatite, tricalcium phosphate, phosphoric-acid 4 calcium, or to use two or more sorts of mixed fine particles etc. among these.

[0022] Although a calcium phosphate particle may be a porosity particle or you may be a nonvesicular particle, it is the former preferably. As for porosity, in the case of a porosity particle, it is desirable that it is 20 - 70%. pore -- size -- although it is various, it is desirable to have a 10-2000-micrometer diameter.

[0023] Moreover, as for the calcium phosphate particle used for this invention, it is desirable to carry out a temporary-quenching join beforehand before pressurization heat-treatment. The temporary-quenching join temperature in that case has desirable 500-1300 degrees C, and is more desirable. [of 700-1200 degrees C] When temporary-quenching join temperature was lower than 500 degrees C, a calcium phosphate particle becomes easy to collapse and a porous calcium phosphate particle is used during pressurization heat-treatment, it deforms by pressurization, pore is crushed and porosity is lost. If temporary-quenching join temperature is higher than 1300 degrees C, since decomposition or degradation of a calcium phosphate system compound will take place, it is not desirable.

[0024] As for temporary-quenching join time amount (time amount held to the above-mentioned temporary-quenching join temperature), considering as 1 - 10 hours is desirable. The temporary-quenching join effectiveness is not acquired as temporary-quenching join time amount is less than 1 hour, but since change is not looked at by effectiveness even if it processes exceeding 10 hours, it becomes cost quantity. More desirable temporary-quenching join time amount is 2 - 5 hours. Moreover, although especially the ambient atmosphere of a temporary-quenching join is not limited, in order to prevent disassembly of a calcium phosphate system compound, it is desirable to carry out in atmospheric air.

[0025] As for a calcium phosphate particle, it is desirable to carry out grain refining so that mean particle diameter may serve as 0.001 - 10 mm. The mean particle diameter of a calcium phosphate particle is 0.01-6.0mm more preferably. Since a calcium phosphate particle dedrop comes to be easy with 10 mm super-***** from calcium phosphate-synthetic-resin complex, the mean particle diameter of a calcium phosphate particle is not desirable. Moreover, dispersibility turns up that it is it easy to condense to be under 0.001 mm, and cost becomes high.

[0026] [3] Pressurization heat-treatment (1) The pressurization heating method is used for manufacturing calcium phosphate-synthetic-resin complex in pressurization heating apparatus this invention. The pressurization heating method is the approach of heating, while filling up with and pressurizing a calcium phosphate particle and a synthetic-resin particle between the molds of a pair linked to a heat source. As for pressurization heating, it is desirable to carry out in the ambient atmosphere (inert gas replacement) with which a vacuum or oxygen was removed and the inert gas of helium, Ar, and N₂ grade was filled.

[0027] The equipment which performs a vacuum or inert-gas-replacement pressurization heat-treatment is explained with reference to drawing 3 - drawing 5. The pressurization heating apparatus 1 shown in drawing 3 has the punch 4a and 4b which pressurizes the mixture 3 of the calcium phosphate particle with which went up and down the inside of the vacuum chamber 6 in which the vacuum pump 7 was formed, the die 2 arranged in it, and a die 2, and it filled up in the die 2, and a synthetic-resin particle, and the rams 5a and 5b which drive each punch 4a and 4b in a list. In the die 2, the thermocouple (not shown) for measuring processing temperature is formed. Moreover, the gas inlet and the chemical cylinder are formed in the gas cylinder 11.

[0028] It connects with a power source 8 through an electric supply terminal (not shown), and each rams 5a and 5b heat Punch 4a and 4b while they are driven with the pressurization drive 9 and pressurize the mixture 3 of a calcium phosphate particle and a synthetic-resin particle. It connects with the pressurization drive 9, the power source 8, the vacuum pump 7, and the thermocouple, and a control section 10 controls the sintering pressure in a die 2 and sintering temperature, the degree of vacuum in the vacuum chamber 6, etc.

[0029] As shown in drawing 4, a die 2 has cyclic structure and a cross section has mold cavity 2a, such as circular, an ellipse, and a rectangle. Each punch 4a and 4b has a cross section slightly smaller than mold cavity 2a so that the inside of mold cavity 2a of a die 2 may be moved up and down. Each punch 4a and 4b is being fixed to Rams 5a and 5b.

[0030] (2) The calcium phosphate-synthetic-resin complex of this invention has structure joined on the particle front face as the calcium phosphate particle 100 surrounded in the synthetic-resin particle 200 (I) and 200 (II) as shown in restoration drawing 2 of a calcium phosphate particle and a synthetic-resin particle. In order to obtain such calcium phosphate-synthetic-resin complex, it must be made for the synthetic-resin particle 200 (I) and 200 (II) to have to enclose the perimeter of the calcium phosphate particle 100 in the phase which fills up a die with a calcium phosphate particle and a synthetic-resin particle, as shown in drawing 1.

[0031] After mixing a calcium phosphate particle and a synthetic-resin particle, mold cavity 2a of a die 2 is filled up. As for the weight ratio of a calcium phosphate particle / synthetic-resin particle, at this time, 1 / 9 - 8/2 are desirable. 8 / 2 super-**, and the perimeter of a calcium phosphate particle are not filled with a synthetic-resin particle for a weight ratio, but a calcium phosphate particle dedrop comes to be easy. On the other hand, when it is less than 1/9, the rate of calcium phosphate is too low, and since biocompatibility falls, it is not desirable.

[0032] (3) Seal the vacuum chamber 6, deaerate with a vacuum pump 7, and maintain at the degree of vacuum of 10-2 Torr extent, after filling up mold cavity 2a of a die 2 with the mixture 3 of a pressurization heat-treatment calcium phosphate particle and synthetic-resin particle I-II, as shown in drawing 5. Inert gas, such as N₂ gas, and helium, Ar, may permute after that. The oxidative degradation of synthetic resin can be prevented by changing into a deoxidation (low concentration) condition by this processing.

[0033] The pressurization drive 9 operates by the control section 10, it moves in the direction which at least one side of Rams 5a and 5b approaches mutually, and the punch 4a and 4b fixed to these pressurizes the mixture 3 of a calcium phosphate particle and synthetic-resin particle I-II. As for the welding pressure by Punch 4a and 4b, it is desirable to be referred to as 0.5 - 50 MPa, and it is more desirable to be referred to as 1.0 - 20 MPa. If welding pressure is smaller than 0.5 MPa, joining [of synthetic-resin particles] will become inadequate and a particle will dedrop come to be easy from complex. Moreover, even if it makes it larger than 50 MPa, improvement in gestalt holdout

corresponding to it is not obtained, but the problem of a calcium phosphate particle collapsing on the contrary only arises.

[0034] Subsequently, by heating Punch 4a and 4b according to a power source 8, a calcium phosphate particle and synthetic-resin particle I-II are heated under pressurization, and as shown in drawing 2, the synthetic-resin particles I and II join them on a particle front face.

[0035] Heating of the mixture 3 of a calcium phosphate particle and synthetic-resin particle I-II is good to carry out according to the temperature up program set up beforehand. In that case, the thermocouple (not shown) formed in the die 2 detects the temperature of mixture 3, and the output of a thermocouple is inputted into a control section 10. A control section 10 creates the signal for carrying out a temperature up as a temperature up program based on the inputted temperature data, and outputs it to a power source 8. A power source 8 supplies a suitable electrical potential difference to Rams 5a and 5b according to the instruction from a control section 10.

[0036] As for whenever [stoving temperature], it is desirable that it is 130-300 degrees C, and it is more desirable that it is 150-250 degrees C. If whenever [stoving temperature] is less than 130 degrees C, sticking [of synthetic-resin particles] will become inadequate and a particle will dedrop come to be easy from complex. Moreover, since 300-degree-C super-** and a synthetic-resin particle cannot maintain particle shape, but whenever [stoving temperature] may fuse and may unify, it is not desirable.

[0037] As for heating time (time amount held to whenever [stoving temperature]), it is desirable to consider as for 1 - 30 minutes. Since improvement in the adhesion force will not arise even if adhesion of synthetic-resin particles makes it longer than 30 minutes insufficiently if heating time is shorter than 1 minute, it is not desirable. More desirable heating time is for 3 - 10 minutes.

[0038] The calcium phosphate-synthetic-resin complex after pressurization heat-treatment termination is cooled radiationally to a room temperature, and is picked out from a die. When calcium phosphate is not exposed enough on the surface of complex, grinding of the front face may be carried out.

[0039]

[Example] Although the following examples explain this invention to a detail further, this invention is not limited to these.

[0040] The porosity calcium phosphate particle (particle size 0.2 - 0.3 mm, Ca/P ratio 1.67) of 1.500 g which carried out the temporary-quenching join at the atmospheric-air furnace of 11200 degrees C of examples, the bridge formation acrylic fine particles (the mean particle diameter of 15 micrometers, KEMISUNO MX-1500H, and Soken Chemical & Engineering, Inc.) of 1.470 g, and the non-constructing bridge acrylic fine particles (the mean particle diameter of 1.5 micrometers, KEMISUNO MP-1400, and Soken Chemical & Engineering, Inc.) of 30 mg were mixed, and the die (inner 12x22 mm) of pressurization heating apparatus was filled up.

[0041] Next, from the upper and lower sides, 10 MPa was pressurized, and it heated, and held for 5 minutes at 240 degrees C. It cooled after that and pressurization was wide opened at the room temperature.

[0042] Thereby, the calcium phosphate-synthetic-resin complex of 12.0x22.0x6.7 mm has been fabricated. As a result of deleting the front face of this complex 0.2 mm using a milling cutter and observing a front face with an optical microscope and a scanning electron microscope, it had exposed to the front face good, without covering calcium phosphate with acrylic resin. Moreover, the tripartite flexural strength of calcium phosphate-synthetic-resin complex was 27.5 MPa. Furthermore, the tripartite flexural strength of the calcium phosphate-synthetic-resin complex which measured this complex after being immersed into a physiological saline for seven days was 21.5 MPa.

[0043] The porosity calcium phosphate particle (mean-particle-diameter 0.01 mm, Ca/P ratio 1.50) of 2.000 g which carried out the temporary-quenching join at the atmospheric-air furnace of 2700 degrees C of examples, the bridge formation acrylic fine particles (the mean particle diameter of 15 micrometers, KEMISUNO MX-1500H, and Soken Chemical & Engineering, Inc.) of 900 mg, and the non-constructing bridge acrylic fine particles (the mean particle diameter of 0.40 micrometers, KEMISUNO MP-1000, and Soken Chemical & Engineering, Inc.) of 100 mg were mixed, and the die (inner 12x22

mm) of pressurization heating apparatus was filled up.

[0044] Next, from the upper and lower sides, 10 MPa was pressurized, and it heated, and held for 5 minutes at 240 degrees C. It cooled after that and pressurization was wide opened at the room temperature.

[0045] Thereby, the calcium phosphate-synthetic-resin complex of 12.0x22.0x6.0 mm has been fabricated. As a result of deleting the front face of this complex 0.1 mm using a milling cutter and observing a front face with an optical microscope and a scanning electron microscope, it had exposed to the front face good, without covering calcium phosphate with acrylic resin. Moreover, the tripartite flexural strength of calcium phosphate-synthetic-resin complex was 22.2 MPa. Furthermore, the tripartite flexural strength of the calcium phosphate-synthetic-resin complex which measured this complex after being immersed into a physiological saline for seven days was 15.6 MPa.

[0046] The porosity calcium phosphate particle (grain size 0.2 - 0.6 mm, Ca/P ratio 2.0) of 200 mg which carried out the temporary-quenching join at the atmospheric-air furnace of 31100 degrees C of examples, the bridge formation acrylic fine particles (the mean particle diameter of 1.5 micrometers, KEMISUNO MX-150, and Soken Chemical & Engineering, Inc.) of 900 mg, and the non-constructing bridge acrylic fine particles (the mean particle diameter of 1.5 micrometers, KEMISUNO MP-1400, and Soken Chemical & Engineering, Inc.) of 900 mg were mixed, and the die (inner 12x22 mm) of pressurization heating apparatus was filled up.

[0047] Next, from the upper and lower sides, 20 MPa was pressurized, and it heated, and held for 30 minutes at 150 degrees C. It cooled after that and pressurization was wide opened at the room temperature.

[0048] Thereby, the calcium phosphate-synthetic-resin complex of 12.0x22.0x6.5 mm has been fabricated. As a result of deleting the front face of this complex 0.2 mm using a milling cutter and observing a front face with an optical microscope and a scanning electron microscope, it had exposed to the front face good, without covering calcium phosphate with acrylic resin. Moreover, the tripartite flexural strength of calcium phosphate-synthetic-resin complex was 23.8 MPa. Furthermore, the tripartite flexural strength of the calcium phosphate-synthetic-resin complex which measured this complex after being immersed into a physiological saline for seven days was 23.5 MPa.

[0049] The porosity calcium phosphate particle (grain size 1.0 - 3.0 mm, Ca/P ratio 1.67) of 1.500 g which carried out the temporary-quenching join at the atmospheric-air furnace of 41000 degrees C of examples, the bridge formation acrylic fine particles (the mean particle diameter of 90 micrometers, KEMISUNO MR-90G, and Soken Chemical & Engineering, Inc.) of 1.497 g, and 3mg non-constructing bridge acrylic fine particles (the mean particle diameter of 1.5 micrometers, KEMISUNO MP-1400, and Soken Chemical & Engineering, Inc.) were mixed, and the die (inner 12x22 mm) of pressurization heating apparatus was filled up.

[0050] Next, from the upper and lower sides, 5MPa(s) were pressurized, and it heated, and held for 10 minutes at 240 degrees C. It cooled after that and pressurization was wide opened at the room temperature.

[0051] Thereby, the calcium phosphate-synthetic-resin complex of 12.0x22.0x7.3 mm has been fabricated. As a result of deleting the front face of this complex 0.2 mm using a milling cutter and observing a front face with an optical microscope and a scanning electron microscope, it had exposed to the front face good, without covering calcium phosphate with acrylic resin. Moreover, the tripartite flexural strength of calcium phosphate-synthetic-resin complex was 26.3 MPa. Furthermore, the tripartite flexural strength of the calcium phosphate-synthetic-resin complex which measured this complex after being immersed into a physiological saline for seven days was 18.6 MPa.

[0052] The 2.40g porosity calcium phosphate particle (grain size 0.2 - 0.6 mm, Ca/P ratio 1.67) which carried out the temporary-quenching join at the atmospheric-air furnace of 51200 degrees C of examples, 0.48g bridge formation acrylic fine particles (the mean particle diameter of 3 micrometers, KEMISUNO MX-300, and Soken Chemical & Engineering, Inc.), and the non-constructing bridge acrylic fine particles (the mean particle diameter of 1.5 micrometers, KEMISUNO MP-1400, and Soken Chemical & Engineering, Inc.) of 0.12 g were mixed, and the die (inner 12x22 mm) of pressurization

heating apparatus was filled up.

[0053] Next, from the upper and lower sides, 1 MPa was pressurized, and it heated, and held for 20 minutes at 240 degrees C. It cooled after that and pressurization was wide opened at the room temperature.

[0054] Thereby, the calcium phosphate-synthetic-resin complex of 12.0x22.0x5.8 mm has been fabricated. As a result of deleting the front face of this complex 0.1 mm using a milling cutter and observing a front face with an optical microscope and a scanning electron microscope, it had exposed to the front face good, without covering calcium phosphate with acrylic resin. Moreover, the tripartite flexural strength of calcium phosphate-synthetic-resin complex was 28.2 MPa. Furthermore, the tripartite flexural strength of the calcium phosphate-synthetic-resin complex which measured this complex after being immersed into a physiological saline for seven days was 19.7 MPa.

[0055] The porosity calcium phosphate particle (grain size 0.2 - 0.6 mm, Ca/P ratio 1.67) of 1.50 g which carried out the temporary-quenching join at the atmospheric-air furnace of 61200 degrees C of examples, the bridge formation acrylic fine particles (the mean particle diameter of 90 micrometers, KEMISUNO MR-90G, and Soken Chemical & Engineering, Inc.) of 1.20 g, and the non-constructing bridge acrylic fine particles (the mean particle diameter of 1.5 micrometers, KEMISUNO MP-1400, and Soken Chemical & Engineering, Inc.) of 0.30 g were mixed, and the die (inner 12x22 mm) of pressurization heating apparatus was filled up.

[0056] Next, using pressurization heating apparatus, 10 MPa was pressurized, it heated from the upper and lower sides, and 240 degrees C was held for 5 minutes. It cooled after that and pressurization was wide opened at the room temperature.

[0057] Thereby, the calcium phosphate-synthetic-resin complex of 12.0x22.0x6.9 mm has been fabricated. As a result of deleting this complex front face 0.3 mm using a milling cutter and observing a front face with an optical microscope and a scanning electron microscope, it had exposed to the front face good, without covering calcium phosphate with acrylic resin. Moreover, the tripartite flexural strength of calcium phosphate-synthetic-resin complex was 59.9 MPa. Furthermore, the tripartite flexural strength of the calcium phosphate-synthetic-resin complex which measured this complex after being immersed into a physiological saline for seven days was 38.5 MPa.

[0058] The porosity calcium phosphate particle (grain size 0.2 - 0.6 mm, Ca/P ratio 1.67) of 1.50 g which carried out the temporary-quenching join at the atmospheric-air furnace of 11200 degrees C of examples of a comparison, and the bridge formation acrylic fine particles (the mean particle diameter of 90 micrometers, KEMISUNO MR-90G, and Soken Chemical & Engineering, Inc.) of 1.50 g were mixed, and the die (inner 12x22 mm) of pressurization heating apparatus was filled up.

[0059] Next, using pressurization heating apparatus, 10 MPa was pressurized, it heated from the upper and lower sides, and 240 degrees C was held for 5 minutes. It cooled after that and pressurization was wide opened at the room temperature.

[0060] Thereby, the calcium phosphate-synthetic-resin complex of 12.0x22.0x7.1 mm has been fabricated. As a result of deleting this complex front face 0.3 mm using a milling cutter and observing a front face with an optical microscope and a scanning electron microscope, it had exposed to the front face good, without covering calcium phosphate with acrylic resin. Moreover, the tripartite flexural strength of calcium phosphate-synthetic-resin complex was 55.1 MPa. However, the tripartite flexural strength of the calcium phosphate-synthetic-resin complex which measured this complex after being immersed into a physiological saline for seven days was below 2.0 MPa.

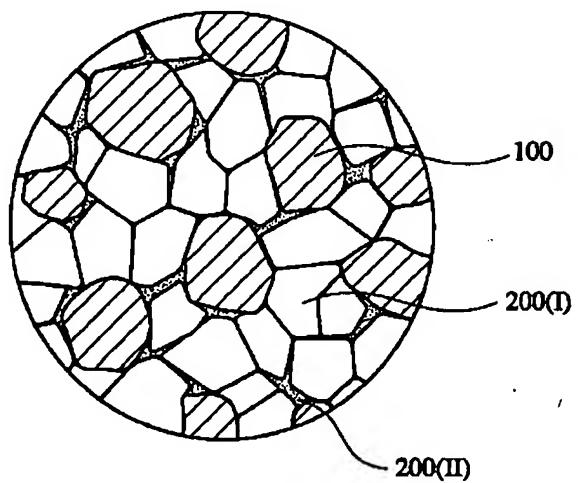
[0061]

[Effect of the Invention] The calcium phosphate-synthetic-resin complex of this invention has structure which synthetic-resin particles joined on the particle front face as above. Therefore, in the usual condition, although the calcium phosphate particle is firmly held by the synthetic-resin particle, at the time of cutting polish, the particle interface between synthetic-resin particles and the particle interface of a calcium phosphate particle and a synthetic-resin particle separate. Therefore, a synthetic-resin particle fuses, there is no problem of covering the front face of a calcium phosphate particle, and it excels in workability extremely. Moreover, since the synthetic-resin particle II of non-cross-linking is filled up

with the opening between particles and functions as a binder, it can consider as the calcium phosphate-synthetic-resin complex excellent in the stability over moisture.

[0062] The calcium phosphate-synthetic-resin complex of this invention which has this structure is suitable for the application of a dental implant, bone reinforcing materials, etc.

[Translation done.]

Drawing selection Representative drawing 

[Translation done.]